Rehabilitation management of autonomic dysregulation in Post COVID-19 Condition

World Health Organization
Expanding our understanding of Post COVID-19 Condition: Rehabilitation

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Research Instructor
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Identifying a novel post-viral syndrome
The Precision Recovery Protocol

Founders:
Dr. David Putrino, PT, PHD
Dr. Christopher Kellner, MD

Tabacof, et al., Telemedicine and e-Health, 2020
May 2020: A novel post viral condition starts to be identified

Persistent symptoms with a well established medical cause

- PICS (Post Intensive Care Syndrome)
- Pulmonary fibrosis
- Pericarditis/Myocarditis

Persistent symptoms without a well-established cause

Post COVID-19 Condition Post Acute COVID-19 Syndrome (PACS) Long COVID
Patient-reported survey determine rehabilitation needs and outcomes

Demographics; Past medical history; Employment, Physical activity; Testing (PCR/Antibody)/Vaccination status; Acute COVID Illness Severity; PACS: Symptom checklist; Exacerbating factors

Validated PROs:
- Breathlessness: Medical Research Council (MRC) Breathlessness Scale
- Fatigue: Fatigue Severity Scale (FSS) + VAS
- Health related QOL: EuroQol EQ-5D-5L
- Pain VAS
- Participation (WHODAS)
- Depression screening (Patient Health Questionnaire – 2 PHQ-2)
- Anxiety (Generalized Anxiety Disorder Assessment - GAD-7)
- Cognitive function (NeuroQOL Cognitive Function 2.0 8a)
- Sleep: Epworth sleepiness scale + Sleep VAS
Patient Reported Outcomes
<table>
<thead>
<tr>
<th></th>
<th>All patients (n = 156)</th>
<th>Confirmed COVID-19 (87)</th>
<th>Presumed COVID-19 (69)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>107 (69)</td>
<td>54 (62)</td>
<td>53 (77)</td>
</tr>
<tr>
<td>Age y, median (range)</td>
<td>44 (13 to 79)</td>
<td>45 (13 to 79)</td>
<td>44 (14 to 79)</td>
</tr>
<tr>
<td>BMI kg/m², median (range)</td>
<td>24 (16 to 52)</td>
<td>24 (17 to 52)</td>
<td>24 (16 to 42)</td>
</tr>
<tr>
<td>Duration of symptoms in days, median (range)</td>
<td>351 (82 to 457)</td>
<td>350 (157 to 424)</td>
<td>355 (82 to 457)</td>
</tr>
<tr>
<td>PCR completed</td>
<td>98 (63)</td>
<td>57 (66)</td>
<td>41 (69)</td>
</tr>
<tr>
<td>PCR positive</td>
<td>34 (22)</td>
<td>34 (39)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Antibody test completed</td>
<td>149 (96)</td>
<td>86 (99)</td>
<td>63 (91)</td>
</tr>
<tr>
<td>Antibody positive</td>
<td>80 (51)</td>
<td>80 (92)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>PCR and/or antibody positive</td>
<td>87 (56)</td>
<td>87 (100)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Hospitalized for COVID-19</td>
<td>17 (11)</td>
<td>16 (18)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

Received COVID-19 vaccination*  
87 (56)  45 (52)  42 (61)

Most prevalent comorbidities
- Cancer (any type) 30 (20)  10 (11)  20 (29)
- Asthma 30 (20)  13 (15)  17 (25)
- Anxiety 18 (12)  12 (14)  6 (9)
- Depression 13 (8)  8 (9)  5 (7)
- Hypertension 11 (7)  7 (8)  4 (6)

Data are presented as n (%) unless otherwise indicated. BMI = body mass index, PACS = post-acute COVID-19 syndrome, PCR = polymerase chain reaction. *All COVID-19 vaccination occurred after COVID-19 infection.

Tabacof et al, 2021. Post-acute COVID-19 syndrome negatively impacts physical function, cognitive function, health-related quality of life and participation (AJPMR - accepted w/ minor revision)
<table>
<thead>
<tr>
<th>Symptom</th>
<th>% of Patients Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>86%</td>
</tr>
<tr>
<td>Brain fog</td>
<td>69%</td>
</tr>
<tr>
<td>Headache</td>
<td>49%</td>
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<tr>
<td>Sleep disturbance</td>
<td>49%</td>
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<tr>
<td>Dizziness</td>
<td>49%</td>
</tr>
<tr>
<td>Dyspnea</td>
<td>49%</td>
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<tr>
<td>Memory loss</td>
<td>49%</td>
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<tr>
<td>Palpitations</td>
<td>49%</td>
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<tr>
<td>Confusion</td>
<td>49%</td>
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<tr>
<td>General weakness</td>
<td>49%</td>
</tr>
<tr>
<td>Chest pain</td>
<td>49%</td>
</tr>
<tr>
<td>Neuropathic pain</td>
<td>49%</td>
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<tr>
<td>Muscle pain</td>
<td>49%</td>
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<tr>
<td>Temperature dysregulation</td>
<td>49%</td>
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<tr>
<td>Indigestion</td>
<td>49%</td>
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<tr>
<td>Mood alteration</td>
<td>49%</td>
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<tr>
<td>Sweating</td>
<td>49%</td>
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<tr>
<td>Joint pain</td>
<td>49%</td>
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<tr>
<td>Tinnitus</td>
<td>49%</td>
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<tr>
<td>Nausea</td>
<td>49%</td>
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<tr>
<td>Tachypnoea</td>
<td>49%</td>
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<tr>
<td>Vision impairment</td>
<td>49%</td>
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<tr>
<td>Bloating</td>
<td>49%</td>
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<tr>
<td>Sore throat</td>
<td>49%</td>
</tr>
<tr>
<td>Hair loss</td>
<td>49%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>49%</td>
</tr>
<tr>
<td>Sexual dysfunction</td>
<td>49%</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>49%</td>
</tr>
<tr>
<td>Loss of appetite</td>
<td>49%</td>
</tr>
</tbody>
</table>

Triggers of symptom exacerbation:
- Physical exertion 86%
- Stress 69%
- Dehydration 49%

Tabacof et al, 2021 (AJPMR - accepted w/ minor revisions)
63% ≥ Mild cognitive impairment
15% Severe cognitive impairment
NeuroQOL - Cognitive Function

78% Debilitating Fatigue
Fatigue severity score ≥4

40% Debilitating Dyspnea
MRC breathlessness ≥3

Tabacof et al, 2021 (AJPMR - accepted w/ minor revisions)
Full time employment: 76% → 41% post COVID-19

Other impacts in function:
EQ-5D-5L
Reduced Usual Activities and Self Care
Multi-systemic
Relapsing
Persisting Symptoms
Fatigue (82%)
Brain fog (67%)
Headache (60%)
Dizziness (54%)

86%
Post-Exertional
Symptom Exacerbation

Skepticism
Delayed/Missed diagnosis

POTS
(Postural Orthostatic Tachycardia Syndrome)

OI
(Orthostatic Intolerance)

AAG
(Autoimmune Autonomic Ganglionopathy)

Pandys
(Pandysautonomia)

MSA
(Multiple System Atrophy)

NMH
(Neurally Mediated Hypotension)

NCS
(Neurocardiogenic Syncope)

PAF
(Pure Autonomic Failure)

Tabacof et al, 2021 (AJPMR - accepted w/ minor revisions)
The extended autonomic system, dyshomeostasis, and COVID-19

Potential mechanisms:
- Autoimmunity
- Proinflammatory cytokine storm
- immune mediated by the virus itself

Autonomic dysfunction following COVID-19 infection: an early experience

Autonomic dysfunction in ‘long COVID’: rationale, physiology and management strategies
Mount Sinai
Rehabilitation Care Model: Autonomic Conditioning Therapy (ACT) for PACS
Autonomic Conditioning Therapy (ACT) for PACS

Core Multi-disciplinary Team
- Cardiologist/Physiatrists
- Physical therapists
- Strengthening/Conditioning coaches
- Dietitians

Referrals
- Neurology
- GI
- Psychology/Neuropsychology
- ENT (Otorhinolaryngology)
- Cognitive telerehabilitation
- Acupuncture
- Craniosacral/OT

Physical Therapy
Mount Sinai Health System
Trusted Rehabilitation Provider Network

Patient Centered Care

Dr. David Putrino, PT, PHD
Dr. Jenna Tosto-Mancuso, DPT
Dr. Amy Kontorovich, MD, PHD
Dr. Jamie Wood, PT, PHD
Ms. Adena Neglia, MS, RDN
Dr. Joseph Herrera, DO
Dr. Mar Cortes, MD
<table>
<thead>
<tr>
<th>KEY ELEMENTS FOR SAFE PHYSICAL ACTIVITY/EXERCISE PRESCRIPTION</th>
<th>ACTION</th>
</tr>
</thead>
</table>
| **Post Exertional Symptom Exacerbation (PESE)**              | Symptom assessment during session + following days/weeks  
Symptom-titration  
Pacing  
Energy conservation  
Identify symptom exacerbating factors |
| Worsening of symptoms 24-72 hours (up to weeks) following any physical or cognitive exertion |        |
| **Cardiac or Pulmonary Impairment**                          | Cardiac screening: Echocardiogram + EKG  
Investigate chest pressure/pain, breathlessness, tachypnea, tachycardia, palpitations, dizziness/syncope  
Interrupt exercise if any sign of distress. |
| I.e myocarditis/pericarditis; lung fibrosis                   |        |
| **Dysautonomia**                                             | Screening: Active stand test  
Attention to signs of orthostatic intolerance  
Optimized fluid intake  
Compression garments  
Electrolyte supplementation |

Adapted from: World physiotherapy response to COVID-19 briefing paper 9. World Physiotherapy; 2021
PHASE Ia: Supine Movement

PHASE Ib: Upright Isometric Exercises

BREATH WORK
Ventilatory Control
Diaphragmatic/nasal breathing exercises
Goal: Improve autonomic regulation

PHYSICAL THERAPY PROGRAM
≥12 WEEKS

Low-grade, Symptom-titred; Supervised
30-min 1:1 sessions 2x/week

PHASE Ia: Supine Movement
PHASE Ib: Upright Isometric Exercises

PHASE II: Aerobic Interval Training

PHASE III: Submaximal Aerobic Conditioning
Adapted Levine Protocol (Fu and Levine, 2018)

INITIAL EVALUATION
Past medical history
Symptoms
PROs

CARDIAC CLEARANCE
Echo + EKG
Active Stand Test

PREHABILITATION
4 WEEKS

BREATH WORK
Ventilatory Control
Diaphragmatic/nasal breathing exercises
Goal: Improve autonomic regulation

OUTCOMES:
PROs
6MWT/10MWT/Orthostatic Vitals

PROGRESSION:
Exertion (Borg RPE) + Symptom (VAS)
Preliminary data
Completed ACT for PACS (n=37)

- 45(13) y/o
- 86% Female
- Program duration: 90(11)d
- Symptom onset to program start: 251d
- Increase in 10MWT Speed (0.3m/s)*
- Increase in 6MWT Distance*
Thank you
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Dr. Jenna Tosto-Mancuso
Dr. Jamie Wood
Dr. Amy Kontorovich
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Ms. Katie Malone
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Dr. Dahlia Rizk
Dr. Gabriela Rozanski

PACS/Long COVID patients
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Josh Duntz
Mount Sinai Dept of Rehabilitation and Human Performance
RTW Charitable Foundation
American Association of Physical Medicine and Rehabilitation
World Physiotherapy
Frontline workers